REMARKS

The Office Action mailed October 5, 2007, and made final, and the Advisory Action mailed December 27, 2007, have been carefully reviewed and the foregoing amendment has been made in consequence thereof.

Claims 1-31 are now pending in this application. Claims 1-21, 23, and 25-31 stand rejected. Claims 22 and 24 stand objected to.

Applicants acknowledge and thank the Examiner for the indication that Claims 22 and 24 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The rejection of Claims 1-7, 9, 10, 12, 17, 19, 21, 23, and 26-31 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 4,727,325 to Matsui et al. (hereinafter referred to as "Matsui") in view of U.S. Pat. No. 6,414,487 to Anand et al. (hereinafter referred to as "Anand") is respectfully traversed.

Matsui describes an NMR imaging method using a rotating field gradient, including a second step of generating field gradient in a predetermined direction to translate the position of signal in a phase space to appropriate locations, and a third step of generating a rotating field gradient to perform a measuring operation. The rotating field gradient produces a spiral or circular sampling of k-space which is then reconstructed through Fourier transformation or a combination of 2D interpolation and Fourier transformation to produce an image. The method includes varying the amplitude of a field gradient waveform and/or an angular frequency at which a field gradient vector is rotated. Signal sampling includes generating a 90° RF pulse and a field gradient G_Z to excite nuclear spins in a desired slice portion of an object to be inspected. When a time τ has elapsed after the peak of the 90° RF pulse, a 180° RF pulse is generated to form transverse magnetization when a time τ has elapsed after the 180° RF pulse, i.e., at a time t=0. At the time t=0, the field gradients G_x and G_y are generated, and a signal sampling operation is started. Notably, Matsui does not describe or suggest polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Further, as acknowledged on page

3 of the Final Office Action, Matsui does not describe or suggest an elliptical sampling of k-space.

Anand describes that in fast spin echo (FSE) systems "[g]enerally, it is desirable to encode the echoes to place the most desirable echo at the center of k-space and the least desirable echo at the edges of k-space. Spiral and elliptical centric ordered trajectories through k-space have been employed in order to acquire the central portion of k-space first" (column 1, lines 40-45). However, "a typical centric ordered acquisition requires enough memory to store the entire acquisition," (column 1, lines 60-61) and as such, "a need exists for [a] time and memory-efficient technique for acquiring and reconstructing multi-shot, three-dimensional magnetic resonance data" (column 2, lines 1-3). The spiral and elliptical centric ordered trajectories in described in Anand do not describe or suggest datasets that form an elliptical grid in polar coordinates in a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid.

Anand describes a method that includes computing an ordered list of k-space views to be sampled. Each magnetic resonance echo of a train of echoes is phase and frequency encoded into predetermined regions of a three-dimensional k-space according to the ordered list of views. More specifically, two of the dimensions, k_Y and k_Z, are sampled by applying different phase encoding gradients, G_Y and G_Z, during each pulse sequence of the scan, and each acquired magnetic resonance signal contains multiple samples in the k_X direction. Each encoded magnetic resonance echo is sampled to create a row of data. Further, as illustrated in Figures 3 and 4, the method in Anand includes sampling data in a rectangular coordinate grid. Anand does not describe or suggest polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid.

Claim 1 recites a method for a medical examination comprising "polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Matsui nor Anand, considered alone or in combination, describes or suggests a method for medical examination, as recited in Claim 1. More specifically, neither Matsui

nor Anand, considered alone or in combination, describes or suggests polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Matsui describes generating an RF pulse and a field gradient G_Z and, after a time elapse, generating field gradients G_X and G_Y, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Further, neither Matsui nor Anand, considered alone or in combination, describes or suggests datasets that form an elliptical grid in polar coordinates in a k-space. Rather, in contrast to the present invention, Matsui describes a rotating field gradient that produces a spiral or circular sampling of k-space, and Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first.

Accordingly, for at least the reasons set forth above, Claim 1 is submitted to be patentable over Matsui in view of Anand.

Claims 2-7, 9, 10, 12, 17, 19, 21, 23, 30, and 31 depend from independent Claim 1. When the recitations of Claims 2-7, 9, 10, 12, 17, 19, 21, 23, 30, and 31 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 2-7, 9, 10, 12, 17, 19, 21, 23, 30, and 31 likewise are patentable over Matsui in view of Anand.

Claim 26 recites a method for a medical examination comprising "sampling datasets on to an elliptical grid in polar coordinates in a k-space to generate signals representative of an object of interest that is being medically examined, wherein the dataset are frequency encoded in a Z-direction of the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Matsui nor Anand, considered alone or in combination, describes or suggests a method for a medical examination, as recited in Claim 26. More specifically, neither Matsui nor Anand, considered alone or in combination, describes or suggests frequency encoding datasets in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Matsui describes generating an RF pulse and a field gradient G_Z and, after a time elapse,

generating field gradients G_X and G_Y, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Further, neither Matsui nor Anand, considered alone or in combination, describes or suggests sampling datasets on to an elliptical grid in polar coordinates in a k-space to generate signals representative of an object of interest that is being medically examined. Rather, in contrast to the present invention, Matsui describes a rotating field gradient that produces a spiral or circular sampling of k-space, and Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first.

Accordingly, for at least the reasons set forth above, Claim 26 is submitted to be patentable over Matsui in view of Anand.

Claim 27 depends from independent Claim 26. When the recitations of Claim 27 is considered in combination with the recitations of Claim 26, Applicants submit that dependent Claim 27 likewise is patentable over Matsui in view of Anand.

Claim 28 recites a magnetic resonance imaging (MRI) system comprising "a main magnet to generate a uniform magnetic field; a radio frequency pulse generator for exciting the magnetic field; a gradient field generator for generating gradients extending in different directions in the magnetic field; a receiver for receiving magnetic field magnetic resonance (MR) signals representative of an object; and a controller for polar phase encoding to generate the MR signals forming datasets representative of the object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Matsui nor Anand, considered alone or in combination, describes or suggests a magnetic resonance imaging system, as recited in Claim 28. More specifically, neither Matsui nor Anand, considered alone or in combination, describes or suggests a controller for polar phase encoding to generate the MR signals forming datasets representative of the object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention,

Matsui describes generating an RF pulse and a field gradient G_Z and, after a time elapse, generating field gradients G_X and G_Y, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Further, neither Matsui nor Anand, considered alone or in combination, describes or suggests a controller for forming datasets, wherein the datasets form an elliptical grid in polar coordinates in the k-space. Rather, in contrast to the present invention, Matsui describes a rotating field gradient that produces a spiral or circular sampling of k-space, and Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first.

Accordingly, for at least the reasons set forth above, Claim 28 is submitted to be patentable over Matsui in view of Anand.

Claim 29 recites a controller programmed to "polar phase encode to generate a plurality of magnetic resonance (MR) signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Matsui nor Anand, considered alone or in combination, describes or suggests a controller as recited in Claim 29. More specifically, neither Matsui nor Anand, considered alone or in combination, describes or suggests a controller programmed to polar phase encode to generate a plurality of magnetic resonance (MR) signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Matsui describes generating an RF pulse and a field gradient G_Z and, after a time elapse, generating field gradients G_X and G_Y, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Further, neither Matsui nor Anand, considered alone or in combination, describes or suggests a controller programmed to form datasets, wherein the datasets form an elliptical grid in polar coordinates in a k-space. Rather, in contrast to the present invention, Matsui describes a rotating field gradient that produces a spiral or circular sampling of k-space, and Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first.

Accordingly, for at least the reasons set forth above, Claim 29 is submitted to be patentable over Matsui in view of Anand.

Accordingly, for at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 1-7, 9, 10, 12, 17, 19, 21, 23, and 26-31 be withdrawn.

The rejection of Claims 1-7, 26, and 27 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 6,486,670 to Heid (hereinafter referred to as "Heid") in view of Anand is respectfully traversed.

Anand is described above. Heid describes a method for imaging with NMR. The method includes reading out MR signals under the influence of a magnetic gradient field with the direction of a gradient being modified during the reception so that a k-space trajectory proceeds on a curve. The MR signals are then sampled with the sampling rate varied such that an occupation density of k-space with samples is essentially uniform. More specifically, the received magnetic resonance signals are sampled and digitized according to a time gradient curve. The curved k-space trajectory produces a spiral sampling of k-space. Interpolation samples are arranged on a rectangular grid in k-space and are generated by interpolating (14) the spiral samples (4). Notably, Heid does not describe or suggest polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid.

Claim 1 recites a method for a medical examination comprising "polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid

in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Heid nor Anand, considered alone or in combination, describes or suggests a method for medical examination, as recited in Claim 1. More specifically, neither Heid nor Anand, considered alone or in combination, describes or suggests polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Heid describes a method for magnetic resonance imaging that uses a spiral sampling of k-space by modifying a direction of a gradient, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Further, neither Heid nor Anand, considered alone or in combination, describes or suggests datasets that form an elliptical grid in polar coordinates in a k-space. Rather, in contrast to the present invention, Heid describes received magnetic resonance signals that are sampled and digitized according to a time gradient curve such that the curved k-space trajectory produces a spiral sampling of k-space, and Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first.

Accordingly, for at least the reasons set forth above, Claim 1 is submitted to be patentable over Heid in view of Anand.

Claims 2-7 depend from independent Claim 1. When the recitations of Claims 2-7 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 2-7 likewise are patentable over Heid in view of Anand.

Claim 26 recites a method for a medical examination comprising "sampling datasets on to an elliptical grid in polar coordinates in a k-space to generate signals representative of an object of interest that is being medically examined, wherein the dataset are frequency encoded in a Z-direction of the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Heid nor Anand, considered alone or in combination, describes or suggests a method for a medical examination, as recited in Claim 26. More specifically, neither Heid nor Anand, considered alone or in combination, describes or suggests frequency encoding datasets in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Heid describes a method for magnetic resonance imaging that uses a spiral sampling of k-space by modifying a direction of a gradient, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Further, neither Heid nor Anand, considered alone or in combination, describes or suggests sampling datasets on to an elliptical grid in polar coordinates in a k-space to generate signals representative of an object of interest that is being medically examined. Rather, in contrast to the present invention, Heid describes received magnetic resonance signals that are sampled and digitized according to a time gradient curve such that the curved k-space trajectory produces a spiral sampling of k-space, and Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first.

Accordingly, for at least the reasons set forth above, Claim 26 is submitted to be patentable over Heid in view of Anand.

Claim 27 depends from independent Claim 26. When the recitations of Claim 27 is considered in combination with the recitations of Claim 26, Applicants submit that dependent Claim 27 likewise is patentable over Heid in view of Anand.

Accordingly, for at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 1-7, 26, and 27 be withdrawn.

The rejection of Claims 1-7, 10, 14, 19, 20, and 25 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 6,794,869 to Brittain (hereinafter referred to as "Brittain") in view of Anand is respectfully traversed.

Anand is described above. Brittain describes a system and method for acquiring (116) data to reconstruct MR images across a large FOV with a reduced acquisition time and without discontinuities of the reconstructed images. The magnetic field gradients that are

used to excite spins traverse k-space in a uniform trajectory in a k-space dimension that is parallel to a motion (146) of an examination table along a Z-axis. More specifically, MR data is acquired (116) by repeatedly applying an excitation that excites spins and by applying magnetic field gradient waveforms to encode a volume of interest (144). The gradients that are perpendicular to the table motion (146) are divided into k_x-k_y subsets. The data is then Fourier transformed in the direction of table motion (146) along the Z-axis, and a final reconstructed image (130) is formed by gridding and Fourier transforming, in a traverse dimension, a fully sampled data array (120). During reconstruction, the phase encodes could be positioned in the k-space plane in the shape of a spiral, in concentric rings, in rays from the center, or in a Cartesian grid. Notably, Brittain does not describe or suggest polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid.

Claim 1 recites a method for a medical examination comprising "polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Brittain nor Anand, considered alone or in combination, describes or suggests a method for medical examination, as recited in Claim 1. More specifically, neither Brittain nor Anand, considered alone or in combination, describes or suggests polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Brittain describes magnetic field gradients traverse k-space in a uniform trajectory in a k-space dimension that is parallel to a motion of an examination table along a Z-axis, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Further, neither Brittain nor Anand, considered alone or in combination, describes or suggests datasets that form an elliptical grid in polar coordinates in a k-space. Rather, in contrast to the present invention, Brittain describes phase encodes that could be positioned in

the k-space plane in the shape of a spiral, in concentric rings, in rays from the center, or in a Cartesian grid, and Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first.

Accordingly, for at least the reasons set forth above, Claim 1 is submitted to be patentable over Brittain in view of Anand.

Claims 2-7, 10, 14, 19, and 20 depend from independent Claim 1. When the recitations of Claims 2-7, 10, 14, 19, and 20 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 2-7, 10, 14, 19, and 20 likewise are patentable over Brittain in view of Anand.

Claim 25 recites a magnetic resonance (MR) method for medical examinations comprising "injecting a patient with a contrast agent that flows into a vasculature of the patient; acquiring MR signals produced by spins in the vasculature from an MR imaging system; and polar phase encoding to generate the MR signals forming datasets representative of the patient by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Brittain nor Anand, considered alone or in combination, describes or suggests a magnetic resonance method, as recited in Claim 25. More specifically, neither Brittain nor Anand, considered alone or in combination, describes or suggests polar phase encoding to generate the MR signals forming datasets representative of the patient by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Brittain describes magnetic field gradients traverse k-space in a uniform trajectory in a k-space dimension that is parallel to a motion of an examination table along a Z-axis, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Further, neither Brittain nor Anand, considered alone or in combination, describes or suggests polar phase encoding to generate the MR signals forming datasets, wherein the datasets form an elliptical grid in polar coordinates in a k-space. Rather, in contrast to the

present invention, Brittain describes phase encodes that could be positioned in the k-space plane in the shape of a spiral, in concentric rings, in rays from the center, or in a Cartesian grid, and Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first.

Accordingly, for at least the reasons set forth above, Claim 25 is submitted to be patentable over Brittain in view of Anand.

Accordingly, for at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 1-7, 10, 14, 19, 20, and 25 be withdrawn.

The rejection of Claims 1-8, 11, 13, and 15 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pub. No. 2002/0175683 to Mertelmeier et al. (hereinafter referred to as "Mertelmeier") in view of Anand is respectfully traversed.

Anand is described above. Mertelmeier describes that the Fourier space, spatial frequency domain or k-space inverse to the spatial or image domain, which the test subject is located, is scanned with a raster of polar coordinates. The graphic presentation of the magnetization, however, is in Cartesian coordinates. The magnetic resonance image then can be generated by re-interpolating the received magnetic resonance signals onto a Cartesian grid and by performing a two-dimensional Fourier transformation.

Mertelmeier also describes a method for fast acquisition of a magnetic resonance image. The method includes using a slice selection gradient in the Z-direction of a rectangular XYZ-coordinate system, and using two gradient fields oriented perpendicularly to the Z-direction and to one another, as a field Gx in the X-direction and a field Gy in Y-direction. However, a phase coding gradient is not used, and, instead, only one frequency coding gradient is used, and possibly a slice selection gradient, if the nuclear spins in only one slice are to be excited. The imaging zone (FOV) is subdivided (100) into sub-regions (fov_i), wherein an antenna (14A-14D) of an antenna array (14) is allocated to each sub-region (fov_i). Each antenna (14A-14D) has a known position relative to the projection center, and the antennas (14A-14D) simultaneously receive the magnetic resonance signals. The antennas (14A-14D) respectively form reception signals from the received magnetic resonance signals according to their sensitivity. Partial images are reconstructed and combined. Notably, Mertelmeier does not describe or suggest polar phase encoding to

generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid.

Claim 1 recites a method for a medical examination comprising "polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

Neither Mertelmeier nor Anand, considered alone or in combination, describes or suggests a method for a medical examination, as recited in Claim 1. More specifically, neither Mertelmeier nor Anand, considered alone or in combination, describes or suggests polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Mertelmeier describes a slice selection gradient in the Z-direction of a rectangular XYZ-coordinate system and two gradient fields oriented in the X-direction and the Y-direction, and Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space.

Accordingly, for at least the reasons set forth above, Claim 1 is submitted to be patentable over Mertelmeier in view of Anand.

Claims 2-8, 11, 13, and 15 depend from independent Claim 1. When the recitations of Claims 2-8, 11, 13, and 15 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 2-8, 11, 13, and 15 likewise are patentable over Mertelmeier in view of Anand.

For at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 1-8, 11, 13, and 15 be withdrawn.

The rejection of Claims 16 and 18 under 35 U.S.C. § 103(a) as being unpatentable over Matsui in view of Anand, further in view of U.S. Pat. No. 6,068,595 to Miyazaki et al. (hereinafter referred to as "Miyazaki") is respectfully traversed.

Matsui and Anand are described above. Miyazaki describes a method of magnetic resonance imaging wherein data reconstruction is accomplished either through a Fourier transform of raw data acquired by magnetic scan under a state wherein pulsed gradients are applied to the subject in phase-encoding, or through pixel addition or maximum intensity projection (MIP). To scan a patient (P), a controller (6) commands a sequencer (5) to start scanning. In response to the command, the sequencer (5) drives a transmitter (8T) and a gradient power supply (4), according to pulse-sequence information that is transmitted and stored, and executes scanning. For a first scan, fast spin echo imaging is selected, the phase-encoding direction is set to the Z-axis direction, and the readout direction is set to the X-axis direction (step S5-2). A phase-encoding direction for a second scan is set to a direction deviated from the phase-encoding direction for the first scan. For example, the phase-encoding direction is changed to the X-axis direction and the readout direction is changed to the Z-axis direction.

Miyazaki does not describe or suggest that the Z-axis and the X-axis directions are defined in k-space for the first and/or second scans. In fact, as illustrated in Figures 4, 7-10, 13, an 16, the Z-axis and the X-axis are defined in real-space and are determined with respect to the patient (P). Furthermore, the directions of the phase-encoding and readout gradient described in Miyazaki do not polar phase encode to generate a plurality of signals forming datasets representative of an object. Moreover, Miyazaki does not describe or suggest phase encoding on to an elliptical grid in polar coordinates in a k-space.

Claims 16 and 18 depend from independent Claim 1 which recites a method for a medical examination comprising "polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid."

None of Matsui, Anand, and Miyazaki, considered alone or in combination, describe or suggest a method for a medical examination, as recited in Claim 1. More specifically, none of Matsui, Anand, and Miyazaki, considered alone or in combination, describe or

suggest polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the Z-direction is substantially parallel to a center axis of an elliptical grid. Rather, in contrast to the present invention, Matsui describes generating an RF pulse and a field gradient G_Z and, after a time elapse, generating field gradients G_X and G_Y, Anand describes applying different phase encoding gradients in the Y- and Z-directions of k-space during each pulse sequence of the scan such that each acquired magnetic resonance signal contains multiple samples in the X-direction of k-space, and Miyazaki describes a method for magnetic resonance imaging that uses pixel addition or maximum intensity projection.

Further, none of Matsui, Anand, and Miyazaki, considered alone or in combination, describe or suggest datasets that form an elliptical grid in polar coordinates in a k-space. Rather, in contrast to the present invention, Matsui describes a rotating field gradient that produces a spiral or circular sampling of k-space, Anand describes spiral and elliptical centric ordered trajectories through k-space that are used to acquire a central portion of k-space first, and Miyazaki describes changing the phase-encoding direction and/or the readout direction from a real-space X-axis direction to a real-space Z-axis direction, or vice versa.

Accordingly, for at least the reasons set forth above, Claim 1 is submitted to be patentable over Matsui in view of Anand and further in view of Miyazaki.

When the recitations of Claims 16 and 18 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 16 and 18 likewise are patentable over Matsui in view of Anand and further in view of Miyazaki.

For at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 16 and 18 be withdrawn.

Claims 22 and 24 were indicated as being allowable had they not been based upon a rejected base claim. Claims 22 and 24 depend from independent Claim 1. Claim 1 is submitted to be in condition for allowance. When the recitations of Claims 22 and 24 are considered in combination with the recitation of Claim 1, Applicants submit that Claims 22 and 24 are likewise in condition for allowance.

In view of the foregoing amendment and remarks, all the claims now active in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited.

Respectfully submitted,

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